Virginia Department of Transportation
Materials Division
Asphalt Field Technician
Proficiency Test

Student Copy
Class Handout

Student Name (print) _____

Student I.D. Number _____

Company Name
(VDOT Employees - Dist./ Div.) _____

Company Address _____

_____

Employer's Phone No. _____

Student must show photo id.

		Test		Retest	
		P	F	P	F
	Standard Count -Nuclear Gauge				
VTM -22	Field Determination of Percent Density of Compacted Asphalt Concrete Mixtures (TL-60)				
VTM -6	Field Determination of Bulk Specific Gravity of Asphalt Concrete Mixtures (TL-60)				
VTM -76	Roller Pattern (TL-56, TL-57)				
VTM -76	Control Strip (TL-58, TL-60)				
VTM-76 & Section 315	Test Section (TL-59)				

Comments:

_____

_____

_____

Student Signature _____ Date _____

Examiner's Name (print) _____

Examiner's Signature _____ Date _____

Nuclear Gauge Procedures

Note to Examiner: ***Student must be 18 years of age, able to lift 30 lb, and must wear safety shoes. Provide student with a thin-lift nuclear gauge and reference block and an air gap spacer.***

Gauge Warm Up and Standard Count Procedure

This test must be demonstrated.	Test	Retest
▪ Standard counts should be taken on the job site at the beginning of each workday.		
▪ At least 10 feet from any structure and 33 feet from other radioactive sources.		
▪ Dry, flat area of asphalt or concrete at least 4 inches thick		
▪ Wear TLD. Warm up gauge.		
▪ Place reference block on flat surface and place air gap spacer on it.		
▪ Gauge in “Safe” position. Handle side of gauge on the 2-legged side of spacer.		
▪ Take standard count		
▪ After beep - record the count and accept count by pressing “yes”.		

You will be conducting a Roller Pattern, Control Strip and Test Section. Tell me how to run each test. When needed, I will give you the appropriate form to complete. I may ask you some questions to prompt you for more information.

	Test	Retest
Equipment		
▪ Approved Paving Equipment (pavers, rollers)		
▪ Thin lift nuclear density gauge		
▪ Nuclear gauge template & white or other approved spray paint		
▪ Device that will measure up to 1000 linear feet		
▪ Rotary saw or coring machine		
▪ Equipment to weigh cores or plugs		

VTM -76
Roller Pattern

	Test	Retest
Give student prepared TL-56 and TL-57 forms.		
Procedure:		
▪ Roller pattern length is 75 feet plus an additional 50 feet on either end to accommodate roller positioning.		
▪ If it is a mix that you have no experience with, it is recommended that you start by making two passes before taking a reading.		
What makes a pass?		
▪ A pass is counted each time the roller passes over the same spot.		
▪ Make 2 passes w/roller, straight up and back then move over to the other side of the land and repeat.		
▪ Take a random density reading at each of the three marked locations within the 75-ft section.		
▪ To take readings nuclear gauge should be parallel with the roadway with the source toward the paving train and no closer than **18 inches** to an unsupported edge for a base mix and **12 inches** for an intermediate or surface mix.		
Give student Roller Pattern sheet to explain and show random reading locations		
▪ Select 2 locations about 30 feet apart on one side of the lane and 1 location on the opposite side of the lane about 15 ft from each of the first two sites		
▪ Using template and spray paint mark each location. (DO NOT paint the gauge!!)		
▪ Gauge should be in test position and set in **30 second** mode.		
▪ Average the readings from the 3 test site locations and plot the density versus the number of roller passes on the TL-57.		
▪ Repeat this procedure until optimum density is obtained.		
Two sets of readings are already averaged. Plot them on the TL-57. Then I will give you 3 more readings to calculate density and plot. Tell me when to stop giving you sets of numbers (when you determine the optimum density) Then fill in answers on the shaded areas of the forms.		

▪ Process shall continue until average density decreases. After the first decrease, make 1 additional pass to insure this was not a false break. This pass will be made with roller in static mode. If mat continues to decrease in density, then optimum density is density achieved one roller pass before the initial decrease in density.		
▪ Typically a **decrease in density of 0.5 lb/ft^3** indicates that optimum density has been achieved.		
What is a false break?		
▪ Density increases on next roller pass after a decrease in density.		
What would you do if a false break occurs?		
▪ Continue to make passes with roller in static mode until the density decreases a second time. Once the density has decreased, make an additional pass in static mode. If the density decreases on this pass, then the optimum density will be the density achieved one roller pass before the second decrease. If the density increases, repeat these steps until optimum density has been achieved.		

We use maximum density and optimum density interchangeably. That's ok

VTM-76
Control Strip Density & Roller Pattern

	Test	Retest
Procedure:		
▪ Control strip length is 300 feet.		
▪ Roll using the same number of passes it took to obtain optimum density in Roller Pattern.		
▪ Select the 10 reading sites, using Stratified Random numbers - given to VDOT inspector before testing begins.		
▪ Use template to mark test site locations. Template should be parallel with the roadway with the arrows toward the paving train. ▪ To take readings nuclear gauge should be parallel with the roadway with the source toward the paving train and no closer than **18 inches** to an unsupported edge for a base mix and **12 inches** for an intermediate or surface mix.		
▪ Nuclear gauge readings shall be taken in the test position and **one minute mode.** ▪ Record readings on the TL-58		
Using the TL-58 and TL-60 forms:		
▪ Add and average readings. ▪ Transfer densities to column H of the TL-60.		
▪ Select sites to be cored - 3 sites closest to target density (circle them).		
▪ Core and run bulk density by VTM-6.		
▪ Average SSD Bulk Specific Gravity per site.		
▪ Average percent density - VTM-22.		
Is this Control Strip acceptable? Why or why not?		
▪ Density meets or exceeds minimum density requirement of Table III-3 of Section 315 Road & Bridge Spec.		
▪ This becomes the target density if acceptable.		

VTM - 22
Field Determination of Percent Density of Compacted Asphalt Concrete Mixtures

	Test	Retest
Procedure		
▪ Using a rotary saw as specified by VDOT cut two 4 x 4 inch specimens or using a coring machine, cut two 4 inch diameter core specimens.		
▪ Three sites selected for coring/sawing are closest to target density.		
▪ Cores shall be cut dry.		
▪ Freeze the roadway using CO_2 or dry ice.		
▪ Cut the core and freeze road again.		
▪ Gently pry around core or plug to break it loose from underlying layer.		
▪ Care taken not to crack or break off any part of the core.		
▪ Measure thickness of test specimen and record it on the TL-60.		
▪ Determine bulk specific gravity according to VTM-6.		
What would you do if the core/plug is damaged?		
▪ Discard and use another core/plug taken from the same area.		
▪ Percent Density = $\frac{\text{Bulk Specific Gravity}}{\text{Theoretical Maximum Specific Gravity}}$ X 100		
▪ Report depth to nearest 0.1 inch.		
▪ Report percent density to nearest 0.1 percent.		
Is theoretical maximum specific gravity used throughout the job?		
▪ Theoretical maximum specific gravity used as denominator for the percent compaction determination shall be determined by a moving average of 5 values. ▪ Until 5 values are obtained, the theoretical maximum specific gravity used shall be a simple average. ▪ Theoretical maximum specific gravity of mixture is supplied by lab testing.		
What percent difference in density is allowed between two specimens from the same test site.		
▪ No more than 2.0%.		
What would you do if the difference was more than allowed?		
▪ Obtain two more specimens from the next test site closest to target density.		

VTM - 6
Field Determination of Bulk Specific Gravity of Compacted Asphalt Mixtures Using Saturated Surface Dry Specimens

This test must be demonstrated on one core.	Test	Retest
Give student TL-60 to show calculations		
Equipment		
▪ Balance - 2000 gram - accuracy 1.0 gram		
▪ Balance equipped with suitable suspension apparatus and holder to permit weighing the specimen while suspended from the center of scale pan of balance.		
▪ Water Bath - for immersing the specimen in water while suspended under the balance.		
▪ Holder shall be immersed in water to a depth sufficient to cover it and the test sample during weighing.		
Steps - Show work on TL-60 (No need to designate A,B,C)		
▪ Weigh specimen in air. Column A on TL-60. (This is "A" in the VTM calculation.)		
▪ Immerse specimen in water bath for one minute and determine the weight. Column B on TL-60. (This is "C" in the VTM calculation.)		
▪ Surface dry the specimen by quickly blotting all sides with a towel and then weigh in air. Column E on TL-60. (This is "B" in the VTM calculation.)		
▪ If specimen removed by a process that does not use water, no further drying is needed. ▪ Wet specimens removed by coring shall be dried to a constant mass a 125± 5°F until further drying does not alter the mass 0.1percent. (Initially dried overnight and then weighed at 2 hour intervals).		
▪ Calculate the bulk specific gravity : $\frac{A}{B-C}$ Show work on TL-60.		
▪ Report value to two decimal places.		
▪ Repeat this process for all of the cores or plugs		

VTM-76 / Rd. & Bridge Spec. Section 315
Test Section

	Test	Retest
Steps		
▪ After the target density is set by the control strip the rest of the project is divided into test section lots The test section lots shall be 5000 feet in length. Each lot is divided into five sublots of 1000 feet.		
▪ Roll using the same number of passes as used for the Control Strip.		
▪ 10 density reading locations are determined by stratified random numbers given to VDOT inspector before testing begins.		
▪ Mark with template and paint parallel with the roadway with the arrows toward the paving train. To take readings nuclear gauge should be parallel with the roadway with the source toward the paving train and no closer than **18 inches** to an unsupported edge for a base mix and **12 inches** for an intermediate or surface mix.		
▪ Nuclear gauge readings shall be taken in the test position and one **minute mode**. ▪ Record readings on the TL-59.		
Give student TL-59 to Complete		
▪ Average each set of sublot readings.		
▪ Determine average density reading.		
▪ Compare average density with Control Strip Target Density to determine if acceptable. [Divide Average Density by Control Strip Target Density x 100.]		
Is this Test Section acceptable? Why or why not?		
Average density must fall within acceptance range of 98-102 % of target density. No two consecutive sublot readings shall have density readings outside of the acceptance range.		

VIRGINIA DEPARTMENT OF TRANSPORTATION
ASPHALT NUCLEAR DENSITY WORKSHEET
ROLLER PATTERN/SAWN PLUGS & CONTROL STRIP TARGET DENSITY

Control Strip No. 1

Schedule PM-1C-05 Item No. G Date 10/28/05

Route 11 From: MP 6.59 To: MP 8.32

Lane Direction: NBL (NBL, SBL, etc.) Lane Inside (inside, center, etc.)

Mix Type SM-12.5D(M) Application Rate: 220 lbs/yd² (kg/m²)

Lot No Width of Application Lot Length ft (m)

Mix Producer Ace Asphalt Plant Location Macey, VA

NUCLEAR CALIBRATION CHECK											
	A	B	C	D	E	F		G		H	
Sawed Spec. Number	Weight in Air (g)	Weight in Water (Total g)	Basket Tare Weight (g)	Weight in Water (g) B - C	SSD Weight In Air (g)	Volume E-D	SSD Bulk Specific Gravity A ÷ F	Average SSD Bulk Per Site	Sawed Specimen Thickness In. (mm)	Target Test Site Nuclear (from TL-58)	
1	1141.7	647.0	----	647.0	1147.3	500.3	2.28	2.28	2.1		1
2	1369.8	774.9	---	774.9	1375.4	600.5	2.28		2.1		2
											3
3	1234.1	706.6	---	706.6	1239.5	532.9	2.32	2.33	2.0		4
											5
4	1212.4	698.2	---	698.2	1213.1	514.9	2.34		2.0		6
											7
5	1218.3	704.7	---	704.7	1221.4	516.7	2.36		2.3		8
											9
6			---						2.3		10
											Total
							Average				
								(Sum of G/3)		(Sum ofH/10)	

Max Specific Gravity (G_{mm}) 2.489

A. Sawed Specimen Average % Density (avg. SSD Bulk Sp. Gr. /G_{mm} x 100)

B. Minimum Design Density (Table III – 3 of sec. 315)
*(A must equal or exceed B)

C. Target Nuclear Density

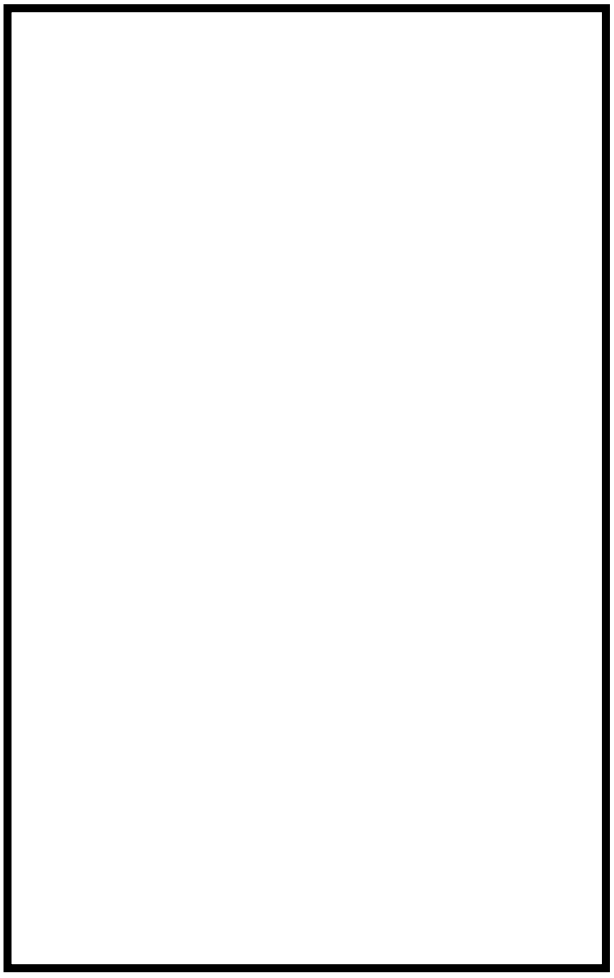
Gauge Model 4640B Serial No. 2325 Calibraton Date 8/14/05 Depth Setting 2.0 In (mm)

Ton (Metric Ton)

Testing Performed by Observed by

Reading Sites for Roller Pattern

Mark locations for taking nuclear density readings.
This represents one lane



TL-56(Rev- 4/05)

ASPHALT NUCLEAR DENSITY THIN LIFT WORKSHEET
ROLLER PATTERN

Control Strip No 1

Project or Schedule PM-1C-05 Item No. C Date 10/28/05

Route 72 From MP 6.59 To MP 8.32

Directional Lane NBL (NBL, SBL, etc.) Lane Inside (inside, center, etc.)

Mix Type SM12.5D(M) Application Rate: 220 lbs/yd² ( ) kg/m²)

Producer ACE Asphalt Location Macey, VA

Roller Type: Roller 1 DD-1234 Roller 2 DD-4756 Roller 3

Roller Pattern Data

Gauge Model 4640B Serial No 2625 Calibration Date 8/14/05 Depth Setting 2.0" in. (mm)

Pass No 2 V	Nuclear Density	Pass No	Nuclear Density
Site 1	142.3	Site 1	
Site 2	141.6	Site 2	
Site 3	142.1	Site 3	
AVERAGE	142.0	AVERAGE	

Pass No 3V	Nuclear Density	Pass No	Nuclear Density
Site 1	146.0	Site 1	
Site 2	148.1	Site 2	
Site 3	145.7	Site 3	
AVERAGE	146.6	AVERAGE	

Pass No 4S	Nuclear Density	Pass No	Nuclear Density
Site 1		Site 1	
Site 2		Site 2	
Site 3		Site 3	
AVERAGE		AVERAGE	

Pass No	Nuclear Density	Pass No	Nuclear Density
Site 1		Site 1	
Site 2		Site 2	
Site 3		Site 3	
AVERAGE		AVERAGE	

Testing Performed by Observed by
VDOT Inspector

TL-57 (Rev. 4/05)

ASPHALT NUCLEAR DENSITY THIN LIFT WORKSHEET
ROLLER PATTERN

Control Strip No: 1

Project or Schedule: PM-1C-05 Item No: C Date: 10/28/05

Route: 72 From: MP 6.59 To: MP 8.32

Directional Lane: NBL (NBL, SBL, etc) Lane: Inside (Inside, Center, etc.)

Mix Type: SM-12.5D(M) Application Rate: 220 lbs/yd² ( ) kg/m²)

Producer: ACE Asphalt Location: Macey, VA

Gauge Model: 4640B Serial No: 2625 Calibration Date: 8/14/05 Depth Setting: 2.0" in. (mm)

DENSITY lbs/ft³ (kg/m³)

NUMBER OF ROLLER PASSES

Optimum Density: lbs/ft³ (kg/m³)
(from peak of roller pattern curve)

Optimum Number of Passes:

Number of Roller Passes: Roller 1 Roller 2 Roller 3

Testing Performed By: Observed By: VDOT Inspector

TL-58 (Rev. 4/05)

VIRGINIA DEPARTMENT OF TRANSPORTATION
ASPHALT NUCLEAR DENSITY THIN LIFT WORKSHEET
CONTROL STRIP TARGET DENSITY

Control Strip Number: 1

Project or Schedule	PM-1C-05	Item Number	C	Date	10/28/05
Route	72	From	6.59	To	8.32
Directional Lane	NBL (NBL, SBL, etc)			Lane	Inside (Inside, Center, etc.)
Mix Type	SM-12.5D	Application Rate	220	lbs/yd²	(kg/m²)
Producer	Ace Asphalt	Location	Macey, VA		

CONTROL STRIP TARGET DENSITY DETERMINATION

TEST SITE	DISTANCE	OFFSET	ENTER GAUGE READING		
Site 1	83 Ft.	6 Ft Lt	142.5	lb/ft³	(kg/m³)
Site 2	19 Ft.	2 Ft. Lt	144.3	lb/ft³	(kg/m³)
Site 3	73 Ft.	4 Ft. Lt	144.2	lb/ft³	(kg/m³)
Site 4	106 Ft.	4 Ft. Lt	147.7	lb/ft³	(kg/m³)
Site 5	98 Ft.	2 Ft. Lt	144.3	lb/ft³	(kg/m³)
Site 6	180 Ft.	7 Ft. Lt	147.0	lb/ft³	(kg/m³)
Site 7	104 Ft.	3 Ft. Lt	145.8	lb/ft³	(kg/m³)
Site 8	40 Ft.	9 Ft. Lt	145.2	lb/ft³	(kg/m³)
Site 9	360 Ft.	3 Ft. Lt	146.7	lb/ft³	(kg/m³)
Site 10	271 Ft.	5 Ft. Lt	147.3	lb/ft³	(kg/m³)
		Total		lb/ft³	(kg/m³)
		Average		lb/ft³	(kg/m³)

Remarks:

Testing Performed by _____ Observed by _____
VDOT Inspector

TL-59(Rev. 4/05)

ASPHALT NUCLEAR DENSITY TEST SECTION

Project or Schedule: PM-1C-05 | Item No.: C | Date: 10/28/05

Route: 72 | Mile Post From: 6.59

Directional Lane (NBL, SBL, etc.): NBL | Mile Post To: 8.32 | Lane (inside, center, etc.): inside

Mix Type: SM-12.5D(M) | Application Rate: 220 lbs/yd² ( ) kg/m²)

Mix Producer: Ace Asphalt | Plant Location: Macey, VA

Lot No: 1 | Width of Application: 12 | Lot Length: 5000 ft (m)

Gauge Model: 4640B | Serial Number: 2325 | Calibration Date: 8/14/05 | Depth Setting: 2.0" in. (mm)

Sublot Number	Lane (Inside, Center, etc.)	Test Site Location: Distance	Test Site Location: Offset	Nuclear Density lb/ft³ (kg/m³)	Sublot Average lb/ft³ (kg/m³)
1a	Inside	136	4Ft. Lt	142.1	
1b	Inside	794	10Ft. Lt	146.3	144.2
2a	Inside	1252	7Ft. Lt	144.1	
2b	Inside	1631	2Ft. Lt	145.6	144.9
3a	Inside	2256	2Ft. Lt	145.0	
3b	Inside	2759	2Ft. Lt	144.4	144.7
4a	Inside	3308	6Ft. Lt	143.6	
4b	Inside	3652	4Ft. Lt	145.0	
5a	Inside	4162	10Ft. Lt	142.9	
5b	Inside	4938	2Ft. Lt	144.3	
6a					
6b					
7a					
7b					

Average: lb/ft³ (kg/m³)

Target Nuclear Control Strip Density: lb/ft³ (kg/m³)

Control Strip No: 1 | % of Target Nuclear Control Strip Density (Average/Target*100): 98 – 102 (Acceptance Range)

Pay Quantity: Ton (Metric Ton)

Lot length x width x application rate / 18000

Remarks

Testing Performed by | Observed by (VDOT Inspector)

Table III-3 Density Requirements	
Mix Type	Min. Control Strip Density %
SM-9.5A, SM-12.5A	92.5
SM-9.5D, SM-12.5D	92.2
SM-9.5E, SM-12.5E	92.2
IM-19.0A	92.2
IM-19.0D	92.0
BM-25.0A, BM-25.0D	91.5